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(54) **Method of manufacturing a planar carbon segment commutator.**

Herstellungsverfahren eines ebenen Kohlesegmentkommutators.

Méthode de fabrication d'un commutateur plan à segments en charbon.

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(56) References cited:
EP-A- 0 583 892 DE-A- 4 026 951
DE-U- 8 907 045

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Description

The invention relates to a method of manufacturing a planar or face plate commutator for use with contact brushes which bear axially against planar contact surfaces of the commutator, instead of bearing radially as in the case of a cylindrical commutator, and in which the contact surfaces are provided by a plurality of segments (normally arranged in an annular ring) having carbon outer layers for engagement with the contact brushes. EP-A-583892, falling under Article 54(3) EPC, DE-8907045.3 and DE-A4026951 all disclose planar commutators in which a plurality of contact members are first mounted to a base member and then overmoulded with carbon segments.

The present invention provides an alternative method of manufacturing a planar carbon segment commutator. According to the present invention, there is provided a method of manufacturing a planar carbon segment commutator, for an electric motor, comprising the steps of:

forming a plurality of carbon segments by moulding carbon over a plurality of circumferentially spaced contact members, the carbon segments being provided with integral anchor means having interlocking parts which engage the rear surfaces of the contact members.

and subsequently mounting the carbon segments to a base member having a rotational axis, a front end extending, at least in part, transversely to the rotational axis, and a plurality of envelopes extending rearwardly from the front end, the front end of the base member being formed with a plurality of first regions, each of which is in overlapping alignment with at least one envelope, and a plurality of radially extending second regions projecting forwardly of the first regions and respectively disposed between all pairs of adjacent first regions, the rear end of the base member with the contact members disposed respectively adjacent to the first regions of the base member so that the contact members of each adjacent pair are circumferentially separated by the radially extending, forwardly projecting second regions and with the integral anchor means extending rearwardly into the envelopes.

The contact members are preferably overmoulded with a single layer of carbon by injection moulding a mixture of carbon powder and carrier material, such as phenolic resin, but the choice of carrier material and any subsequent heat treatment will depend on the operating requirements of different commutators, in accordance with known technology which forms no part of the present invention. The single layer of carbon formed in

this way may then be divided into individual segments by cutting radial grooves.

Each contact member is preferably formed with at least one through hole, the carbon segment formed on each contact member has a first part, extending through each hole, and the interlocking parts of the carbon segments which engage the rear surfaces of the contact members are integral with the first parts extending through the holes and the contact members. This facilitates the overmoulding process.

The base member may be made of insulating material, such as moulded plastic, or of conductive material, such as aluminium, provided with insulating outer surfaces, e.g., of aluminium oxide.

Preferably, the contact members are formed as integral parts of a sheet of metal and interconnecting parts are removed from the sheet to separate the contact members after the contact members have been overmoulded with carbon.

Where the contact members are of copper, the copper contact members and the overmoulded carbon may be heat treated together before the contact members are attached to the base member.

Although the contact members bearing carbon segments may be attached to a pre-formed base member, preferably of moulded plastics material, the assembled contact members and carbon segments are preferably overmoulded with plastics material embosses the interlocking member. This plastics material embosses the interlocking parts of the anchor means integral with the overmoulding carbon segments.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic plan view of a planar carbon segment commutator not made according to the invention and with different parts at different stages of production;

Figure 2 is a sectional side elevation of the commutator shown in Figure 1, after completion, sectioned along Line II-II of figure 1;

Figure 3 is a perspective view of a contact member forming part of the commutator shown in Figures 1 and 2;

Figure 4 is a schematic plan view of one embodiment of a planar carbon segment commutator made according to the invention and with different parts at different stages of production;

Figure 5 is a sectional side elevation of the commutator shown in Figure 4, after completion, sectioned along Line V-V of Figure 4;

Figure 6 is a plan view of a stamped copper sheet

in which all the contact members of the commutator are integrally interconnected:

Figure 7 is a plan view of the stamped copper sheet shown in Figure 6 together with an annular overmoulded ring of carbon, and

Figure 8 is a sectional side elevation of the sub-assembly shown in Figure 7, sectioned along Line VI-II-VIII of Figure 7.

The planar carbon segment commutator shown in figures 1 and 2 known from EP-A-583 892 belonging to the prior art according to Art 54(3) EPC, has a rotational axis 2 and a pre-moulded plastics base member 1 having a front end 3 extending transversely of the rotational axis 2. The front end 3 of the base member 1 is formed with ten circumferentially spaced first envelopes 4, in the form of shallow blind holes, with ten first regions 9 respectively aligned with and overlapping the first envelopes 4, and with a plurality of radially extending second regions 10 which project forwardly of the first regions 9 so as to be disposed between adjacent pairs of the first regions 9. The front end 3 of the base member 1 is also formed with three second envelopes 14, also in the form of blind holes, surrounding each first envelope 4.

Ten contact members 5, as shown in Figure 3, are formed from stamped copper sheet and have three locking portions 15 bent rearwardly for insertion in the second envelopes 14 to position the contact members 5 forwardly of the first envelopes 4. The contact members 5 are therefore mounted adjacent the first regions 9 and are circumferentially separated by the radially extending, forwardly projecting second regions 10. Barbs 16 on each locking portion 15 engage the internal surface of the blind hole forming the second envelope 14 in which the locking portion 15 is disposed, to resist withdrawal of the locking portion 15 from this blind hole. Each contact member 5 is also formed with a contact tang 24 which is bent, as shown in Figure 3, to form a hook 25, for connecting the armature winding to the commutator, after the contact member 5 has been attached to the base member 1, as shown at the right hand side of Figure 1.

As shown in Figure 3, each contact member 5 is provided with two through holes 12 and with two side notches 26 which are aligned with the first envelopes 4 when the contact members 5 are attached to the base member 1.

The base member 1 and the contact members 5 fitted to the base member 1 are then placed in a suitable mould (not shown) defining an annular cavity surrounding a central ring portion 17 of the base member 1. A mouldable mixture of carbon powder and carrier material, such as phenolic resin, is then injected into the annular mould cavity. This injected material flows through the holes 12 and the side notches 26 formed in the contact members 5 and fills the first envelopes 4 to form an

annular overmoulded ring.

The annular overmoulded ring is subsequently separated into ten carbon segments 7 respectively formed on the ten contact members 5 by cutting radial grooves 23 which extend right through the carbon to the radially extending, forwardly projecting second regions 10 of the front end 3 of the base member 1.

As shown in Figure 2, the carbon segment 7 formed on each contact member 5 has integral anchor means 8 with a first part 13 extending through each hole 12 and each notch as well as an interlocking part 11 engaging the rear surface 6 of the contact member 5 to thereby resist withdrawal of the anchor means 8 from the first envelope 4 with which the contact member 5 is aligned.

The planar carbon segment commutator shown in Figures 4 and 5 differs from that shown in Figures 1 and 2 in that the contact members 5 are attached first to the carbon forming the segments 7, instead of the base member 1. The base member 1 is formed later, in an overmoulding operation in which it is attached to the contact members 5 to thereby hold the carbon forming the segments 7.

To form the commutator shown in Figures 4 and 5, a copper sheet 19 is stamped, as shown in Figure 6 to form ten contact members 5 which are circumferentially separated by radially extending slots 27 and interconnected, around the periphery of the sheet 19, by outer connecting portions 20 and, at the centre of the sheet, by a circular inner connecting portion 21.

As shown in Figure 6, each contact member 5 is formed with three through holes 12, a stem 28 connected to the central connection portion 21, a central contact tang 24 and two side tangs 29.

The stamped sheet 19 is then placed in a mould defining an annular cavity surrounding the central portion of the pressed sheet 19 and radial ribs which fill the slots 27 between adjacent contact members 5 to prevent these slots 27 from being filled with carbon. A mouldable mixture of carbon powder and carrier material is then injected into the mould cavity to form a sub-assembly comprising the stamped sheet 19 and an annular carbon ring 22, as shown in Figures 7 and 8, which may then be heat treated to remove the unwanted constituents of the carrier material mixed with the carbon powder, prior to injection moulding, and to relieve stresses in the copper sheet 19. The outer connecting portions 20 around the periphery of the sheet 19 are removed by cutting the sheet 19 at the parting lines 30. The inner connecting portion 21 is then removed, to separate the central stems 28 of the contact members 5 and these central stems 28 are bent rearwardly to form locking portions 15.

The contact tangs 24 are bent to form hooks 25 for armature windings, and the side tangs 29 are bent rearwardly, as shown in Figure 5.

The sub-assembly is then placed in a further mould (not shown) defining a cavity surrounding the sub-assembly. Plastics material is then injected into the further

mould to form an insulating base member 1, as shown in Figure 5. The plastics material flows around the integral anchor means 8 of the carbon segments 7 formed on the contact members 5, to form first envelopes 4 which surround the anchor means 8, and around the locking means 15 which are thereby embraced by second envelopes 14 which grip the locking portions 15 and so resist withdrawal of the locking means 15 from the base member 1.

The plastics material also flows into the slots 27 left between the contact members 5 so as to divide the front end 3 of the base member 1 into first regions 9 in overlapping alignment with the first envelopes 4 and radially extending second regions 10 projecting forwardly of the first regions 9 so as to separate the contact members 5 of each adjacent pair. The radial grooves 23 which separate the annular carbon ring 22 into segments 7 extend through the carbon forming the segments 7 at least as far as the radially extending, forwardly projecting second regions 10 formed in the front end 3 of the base member 1.

The overmoulded base member 1 is also provided with retaining portions, in the form of a central ring portion 17 and an outer ring portion 18 disposed forwardly of the contact members 5 so as to overlap the contact members 5 and thereby hold the contact members 5 in a fixed relationship to the base member 1. These retaining portions 17 and 18 are subsequently divided into parts by the radial grooves 23.

Although the copper sheet 19 forming the contact members 5 may be planar, the sheet 19 may be formed with a forwardly dished portion 31 as shown, for example, in Figure 8. The contact members 5 are therefore formed with rearwardly offset outer portions 32. This permits the formation of a more bulky and therefore more robust outer retaining ring portion 18. As a result, the first envelopes 4 not only surround the anchor means 8 formed integral with the carbon segments 7, but also surround parts 33 of the segments 7 disposed forwardly of the contact members 5. In this case, the radial grooves 23 separating the segments 7 must also be extended to separate the forwardly disposed parts 33 of the segments 7.

Claims

1. A method of manufacturing a planar carbon segment commutator, for an electric motor, comprising the steps of:

forming a plurality of carbon segments (7) by moulding carbon over a plurality of circumferentially spaced contact members (5), the carbon segments (7) being provided with integral anchor means (8) having interlocking parts (11) which engage the rear surfaces (6) of the contact members (5),

and subsequently attaching the carbon segments to a base member (1) having a rotational axis (2), a front end (3) extending, at least in part, transversely to the rotational axis (2), and a plurality of envelopes (4) extending rearwardly from the front end (3), the front end (3) of the base member (1) being formed with a plurality of first regions (9), each of which is in overlapping alignment with at least one envelope (4), and a plurality of radially extending second regions (10) projecting forwardly of the first regions (9) and respectively disposed between all pairs of adjacent first regions (9), the rear surfaces (6) of the contact members (5) engaging the front end (3) of the base member (1) with the contact members (5) disposed respectively adjacent to the first regions (9) of the base member so that the contact members (5) of each adjacent pair are circumferentially separated by the radially extending, forwardly projecting second regions (10) and with the integral anchor means (8) extending rearwardly into the envelope (4).

2. A method, according to Claim 1, in which the contact members (5) are formed as integral parts of a sheet (19) of metal, and connecting parts (20 and 21) are removed from the sheet (19), to separate the contact members (5), after the contact members (5) have been overmoulded with carbon.
3. A method, according to Claim 1 or Claim 2, in which the contact members (5) are of copper, and the copper contact members (5) and the overmoulded carbon are heat treated together before the contact members (5) are attached to the base member (1).
4. A method according to any one of Claims 1 to 3, in which the base member (1) is formed by moulding plastics material over the contact members (5) and the overmoulded carbon.
5. A method according to Claim 4, in which the base member is formed with retaining portions (17 and 18) disposed forwardly of the contact members (5).
6. A method, according to any one of Claims 1 to 5, in which all the contact members (5) are overmoulded with an annular ring (22) of carbon which is then divided into said carbon segments (7) by cutting radial grooves (23).

Patentansprüche

1. Verfahren zur Herstellung eines ebenen Kohlesegmentkommutators für einen Elektromotor, das die Schritte aufweist, bei denen:

- eine Vielzahl von Kohlesegmenten (7) durch Formen von Kohle über einer Vielzahl von über den Umfang in einem gewissen Abstand voneinander angeordneten Kontaktelementen (5) gebildet wird, wobei die Kohlesegmente (7) mit integralen Ankermitteln (8) versehen werden, die sich gegenseitig verriegelnde Teile (11) haben, die in die hinteren Oberflächen (6) der Kontaktelemente (5) eingreifen, und danach die Kohlesegmente an einem Basisselement (1) befestigt werden, das eine Drehachse (2) hat, ein vorderes Ende (3) hat, das sich, zumindest teilweise, quer zu der Drehachse (2) erstreckt, und eine Vielzahl von Umhüllungen (4) hat, die sich von dem vorderen Ende (3) nach hinten erstrecken, wobei das vordere Ende (3) des Basisselements (1) gebildet wird mit einer Vielzahl von ersten Gebieten (9), von denen jedes bei überlappender Ausrichtung entsprechend mindestens einer Umhüllung (4) angeordnet ist, und mit einer Vielzahl von sich radial erstreckenden, zweiten Gebieten (10), die von den ersten Gebieten (9) nach vorne vorspringen und jeweils zwischen allen Paaren aus angrenzenden ersten Gebieten (9) angeordnet sind, wobei die hinteren Oberflächen (6) der Kontaktelemente (5) in das vordere Ende (3) des Basisselements (1) eingreifen, und dabei die Kontaktelemente (5) jeweils an die ersten Gebiete (9) des Basisselements so angrenzen, daß die Kontaktelemente (5) jedes angrenzenden Paares durch die sich radial erstreckenden, nach vorne vorspringenden zweiten Gebiete (10) über den Umfang getrennt sind, wobei sich die integralen Ankermittel (8) nach hinten in die Umhüllung (4) hinein erstrecken.
2. Verfahren gemäß Anspruch 1, wobei die Kontaktelemente (5) als integrale Teile eines Blechs (19) aus Metall gebildet werden, und Verbindungssteile (20 und 21) aus dem Blech (19) entfernt werden, um die Kontaktelemente (5) zu trennen, nachdem die Kontaktelemente (5) mit Kohle überformt wurden.
 3. Verfahren gemäß Anspruch 1 oder Anspruch 2, wobei die Kontaktelemente (5) aus Kupfer sind, und die Kupferkontaktelemente (5) und der überformte Kohlenstoff zusammen wärmebehandelt werden, bevor die Kontaktelemente (5) an dem Basisselement (1) befestigt werden.
 4. Verfahren gemäß irgendeinem der Ansprüche 1 bis 3, wobei das Basisselement (1) dadurch gebildet wird, daß Kunststoffmaterial über den Kontaktelementen (5) und der überformten Kohle geformt wird.

5. Verfahren gemäß Anspruch 4, wobei das Basisselement mit zurückhaltenden Bereichen (17 und 18) gebildet wird, die vor den Kontaktelementen (5) angeordnet sind.
6. Verfahren gemäß irgendeinem der Ansprüche 1 bis 5, wobei alle Kontaktelemente (5) mit einem Ringwulst (22) aus Kohle überformt werden, der dann durch Schneiden von radialen Rillen (23) in die Kohlesegmente (7) unterteilt wird.

Revendications

1. Procédé de fabrication d'un commutateur plan à segments de carbone pour un moteur électrique, comprenant les étapes suivantes:
former plusieurs segments de carbone (7) par moulage de carbone sur plusieurs éléments de contact (5) espacés à la périphérie, des segments de carbone (7) comportant des moyens d'ancrage d'une pièce (8) ayant des parties d'interverrouillage (11) qui viennent au contact des surfaces arrière (6) des éléments de contact (5),
et fixer ensuite les segments de carbone à un élément de base (1) ayant un axe de rotation (2), une extrémité frontale (3) s'étendant, au moins partiellement, en direction transversale par rapport à l'axe de rotation (2) et plusieurs enveloppes (4) partant vers l'arrière à partir de l'extrémité frontale (3), l'extrémité frontale (3) de l'élément de base (1) comportant plusieurs premières régions (9) dont chacune est en alignement à recouvrement avec au moins une enveloppe (4) et plusieurs deuxième régions (10) à extension radiale et faisant saillie vers l'avant des premières régions (9) et disposées respectivement entre toutes les paires de premières régions adjacentes (9), les surfaces arrière (6) des éléments de contact (5) venant au contact de l'extrémité frontale (3) de l'élément de base (1) avec les éléments de contact (5) disposés respectivement à proximité des premières régions (9) de l'élément de base, de façon que les éléments de contact (5) de chaque paire adjacente soient séparés périphériquement par les deuxième régions (10) à extension radiale et faisant saillie vers l'avant et avec le moyen d'ancrage d'une pièce (8) s'étendant vers l'arrière dans l'enveloppe (4).
2. Procédé selon la revendication 1, dans lequel les éléments de contact (5) sont constitués de parties d'une pièce d'une feuille (19) de métal et des parties de connexion (20 et 21) sont enlevées de la feuille (19) pour séparer les éléments de contact (5) après

que les éléments de contact (5) ont été surmoulés avec du carbone.

3. Procédé selon la revendication 1 ou la revendication 2, dans lequel les éléments de contact (5) sont en cuivre et les éléments de contact en cuivre (5) et le carbone de surmoulage subissent un traitement thermique d'ensemble avant que les éléments de contact (5) ne soient fixés à l'élément de base (1).
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4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel l'élément de base (1) est obtenu par moulage de matière plastique sur les éléments de contact (5) et le carbone de surmoulage.
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5. Procédé selon la revendication 4, dans lequel l'élément de base comporte des parties de maintien (17 et 18) disposées à l'avant des éléments de contact (5).
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6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel tous les éléments de contact (5) sont surmoulés avec une bague annulaire (22) de carbone qui est divisée ensuite pour obtenir lesdits segments de carbone (7) en découpant des rainures radiales (23).
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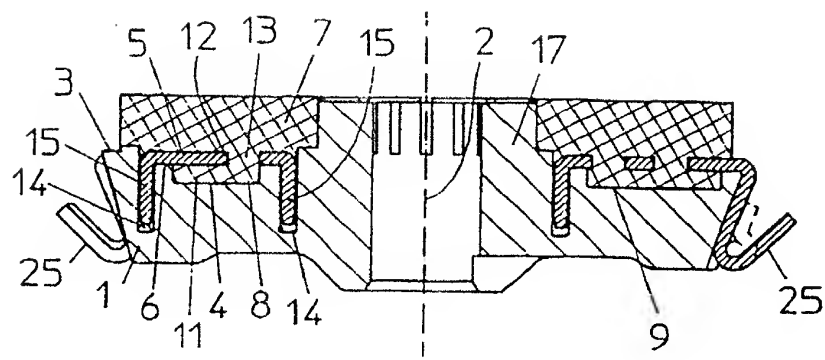


FIG. 2

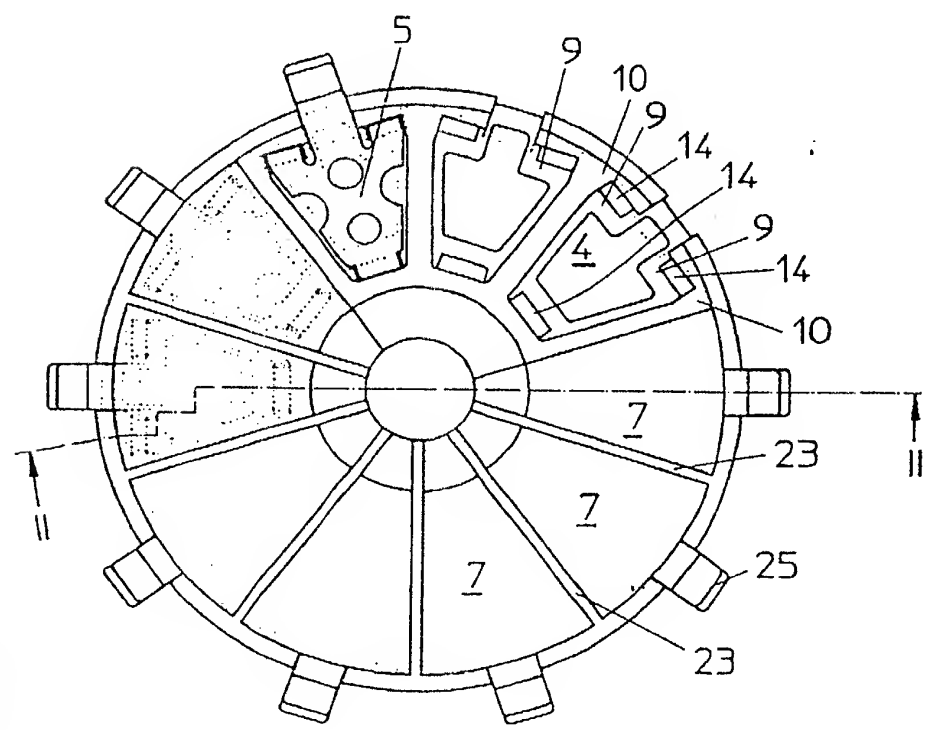


FIG. 1

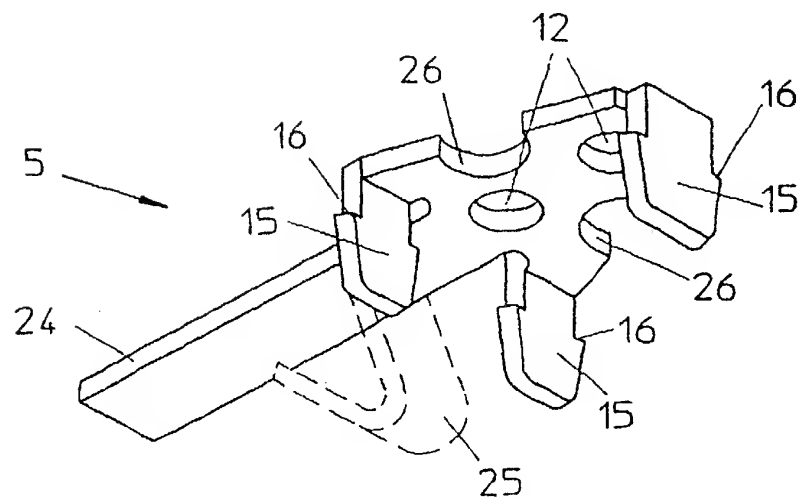


FIG. 3

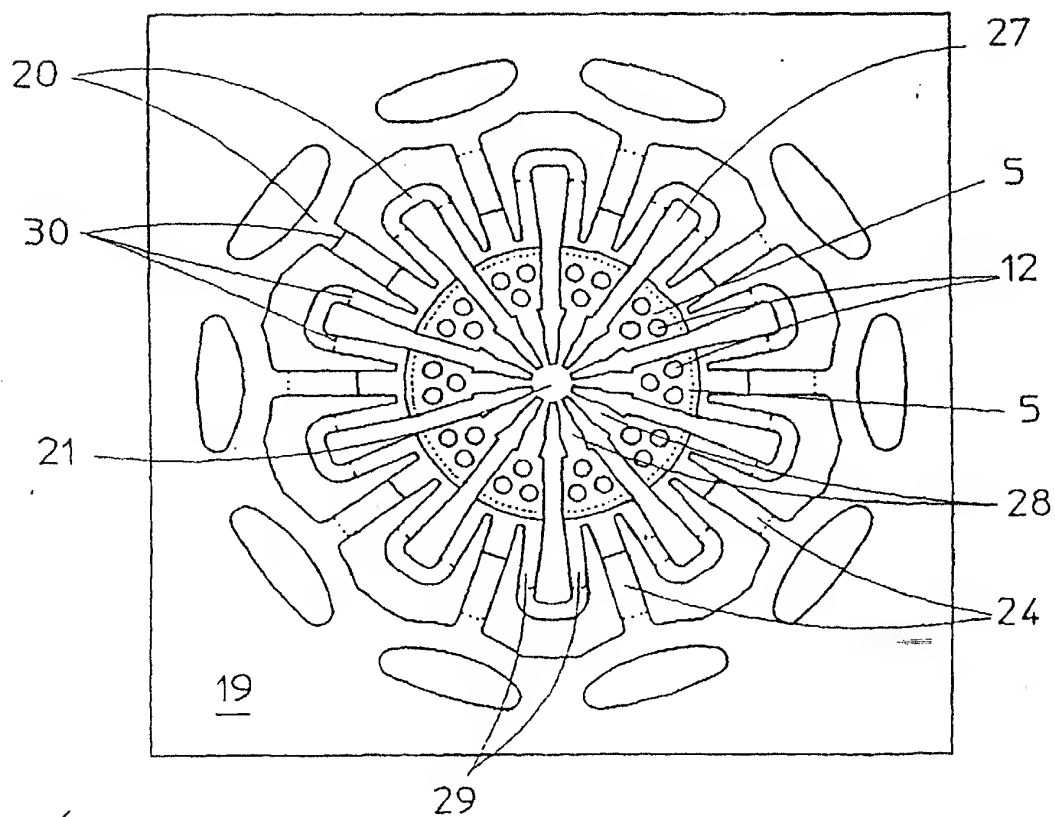


FIG. 6

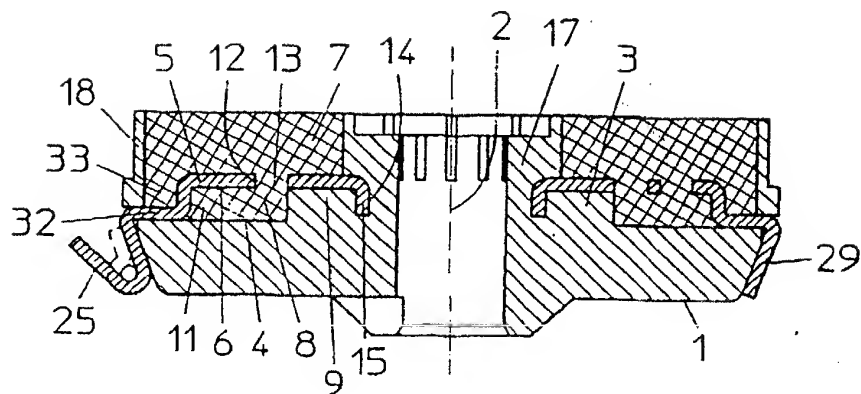


FIG. 5

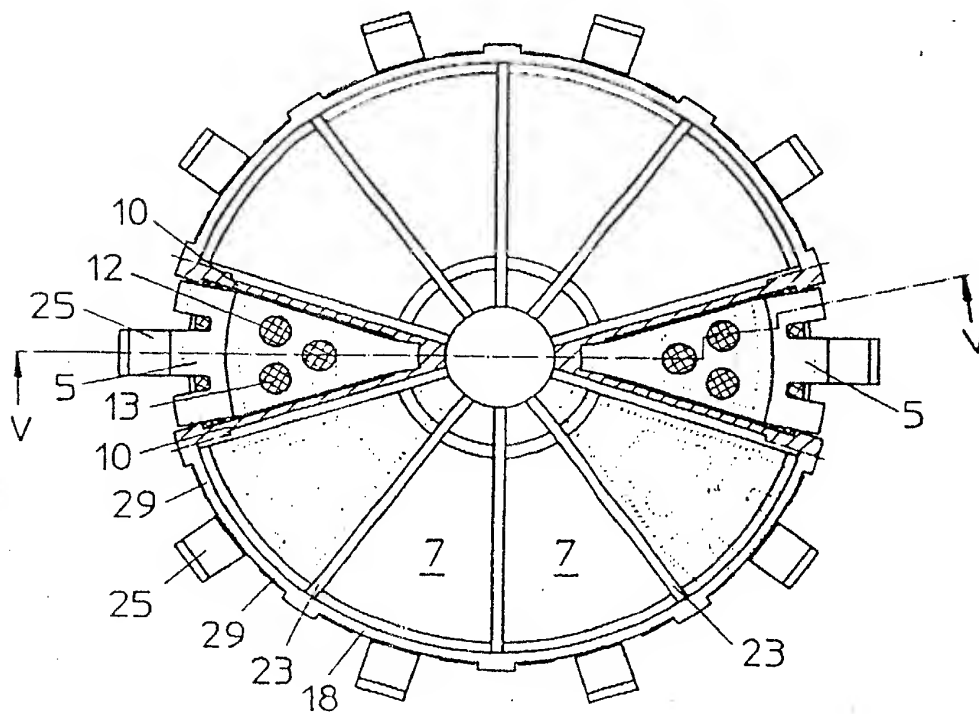


FIG. 4

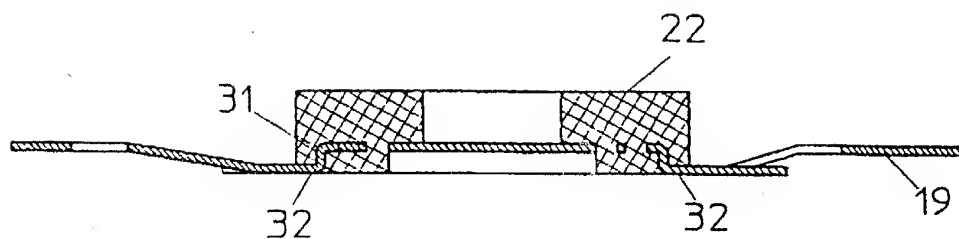


FIG. 8

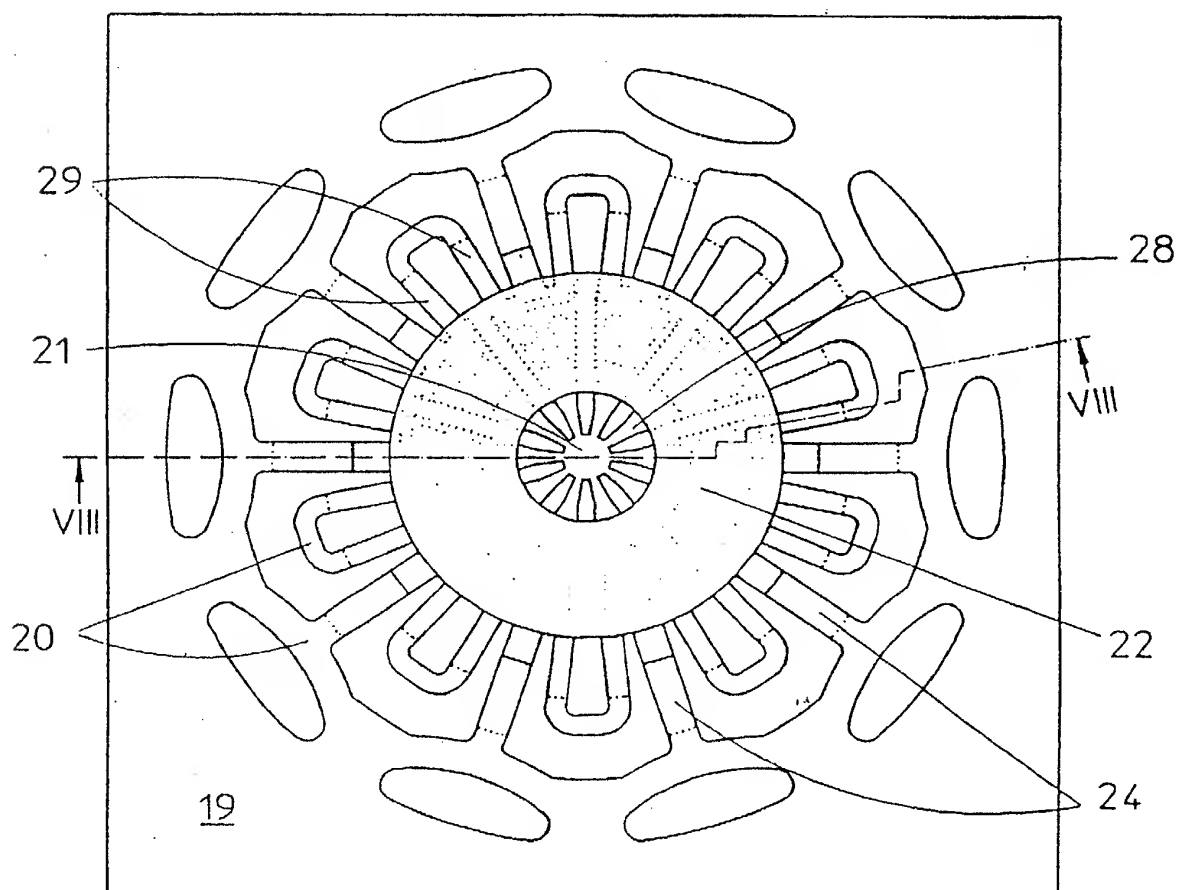


FIG. 7